**Modify Treatment Series** - The "Modify Treatment Series" button is used to change the treatment series. This function is useful when more than one treatment is required. The patient's data is stored for archival purposes.

Evaluation - The operator may choose a previous patient to evaluate past data. Each marker with its deviation at the time of measurement can be displayed. All scaling is done in real coordinates, i.e. all deviations are referenced to the ISO center of the accelerator. All the data is stored in text format for use with standard spreadsheets.

All graphical and tabulated data can easily be printed via a print button associated with each screen.
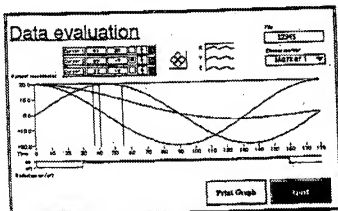
The Data evaluation graph is illustrated above. Simply choose the desired marker(s) to plot the positional change over time. Below the graph of the marker is a bar chart depicting the on/off time of the radiation. In this manner the user can relate marker position to radiation on time.

Equipment List

The MacPosition system includes the following equipment:

Item	Description	Qty.
1	Three-dimensional system, includes:	
	Camera model NP	2
	Video Processor model VP II	2
	f8.5 lens with IR filter	2
	MacReflex 3-D software	
	MacPosition Reflective Markers kit	
2	Macintosh computer with coprocessor (Quadra line preferred for speed) 8 MB of Ram, 120 MB hard disk Graphic acceleration card is recommended.	1
3	MacPosition Software	1
3	Run time version of LabView™	1
4	System cables	lot

Note: User may provide the computer. Qualisys would like to confirm user's choice to ascertain proper system operation.

MacReflex ... the elegant solution.

The application specific software was designed in cooperation with the Radio-Oncology Department of the University Hospital of Zurich, Switzerland.

System Menus

The MacPosition system software was designed with the clinician in mind and as such it uses user friendly menus. The menus are short and self explanatory. The menu shown below illustrates the simplicity of a menu screen.

By clicking on the "Start" button a new screen comes up with a request to enter the patient's data. Once you enter the requested data you can select from the following functions:
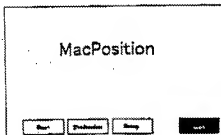
New Series - Loads the previously stored patient's data and allows the operator to increment the treatment series number.

New Patient - A window opens that allows the operator to enter new patient data. After the patient data is entered, another window opens illustrating a body with selected spots reserved for markers. Clicking the marker(s) on the screen activates them for position entry.

The patient's orientation (belly up or belly down) is selected. Marker position tolerances may be entered using the table to the right. The tolerance must be the same for each coordinate (x,y,z).

Record On - Clicking the "Record On" button the data entered is stored and updated in the computer.

Radiation On - Clicking the "Radiation On" button the screen indicates that the radiation treatment beam is turned on.

The new patient window is depicted above. The marker positions are shown on the left and the tolerance entry window for each marker is on the right.

After you enter the information for every new treatment session of a patient, the MacPosition program guides the user through the following procedure:

Repositioning - With the patients specific reference position (in reference to the baseline condition), the patient can be repositioned with the help of MacPosition. The radiologist or the assistant moves the patient to the approximate position. With the assistance of the real-time display of every marker's position, the radiologist quickly moves the patient into the final and exact position. After the repositioning has taken place the treatment cycle can be started.

Patient Position - Looking at the Patient Position screen all the selected markers are displayed in either a red or green condition. The red marker indicates an out of tolerance (position) condition while the green marker indicates a proper position. By clicking the "Record On" button the registration of the markers starts and the coordinate data is stored. Clicking the "Radiation On" a flag is set indicating that the coordinate data were taken while the radiation treatment was on. **This allows the operator to determine the effective movement of the patient during the radiation treatment cycle.**

General Description

MacPosition is a system which was originally developed for positioning and supervision of patients undergoing radiation treatment for cancer. The system is based on the *MacReflex* Motion Measurement System (non-contact) which utilizes passive reflective markers (retroreflectors). This technique is simple to apply, yet it provides highly accurate real-time coordinate data.

Technique

In the initial setup, the patient is placed on the table and is positioned accordingly. The radiologist or the assistant attaches the retroreflective markers on the patient's body per pre-selected marked spots on the patient's skin. This initial setup provides the "baseline" information for the MacPosition software. It is stored in the computer system as a reference for the specific patient.

A set of three markers on the patient serve as a "floating reference" in space. All other markers (patient movements) are tracked in relation to the reference markers. The operator then starts the menu-driven software for positioning and repositioning the patient as necessary. Patient repositioning can be done in real time. The computer display indicates the reference and deviation in x,y and z coordinates. For all future sessions the patient is repositioned simply by going to the "Reposition" menu and viewing the video monitor to quantitatively reposition the patient by observing the actual and "baseline" marker positions. Two sets of markers (red and green) are visible on the monitor. As the patient is moved into position the red and green markers coincide. When aligned the red markers disappear.

System Components

The system is comprised of a *MacReflex* Motion Measurement System in a three-dimensional configuration. Two specially designed CCD digital cameras with associated video processors make up the motion capture unit. The cameras are fitted with infrared filters and a ring of infrared LEDs around the lenses. As a result artificial lighting is not required. Ambient lighting conditions are adequate. In fact the lighting can be reduced without affecting the measurement or the setup. Most video systems would require artificial lighting conditions.

The *MacReflex* video processors are connected to a standard Macintosh computer via the modem port for x,y,z coordinate analysis of the patient's position. All screens are in color and are menu driven for ease of use by the operator.
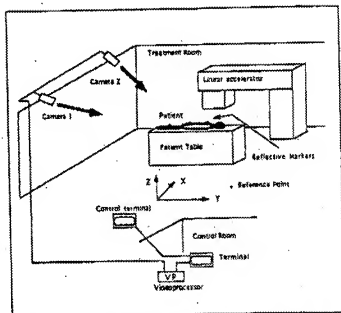
Pictured above is a diagram of the treatment room setup illustrating the positioning of the specially designed infrared CCD digital video cameras and the patient positioned under the radiation unit.

System Software

The software for the MacPosition system integrates the *MacReflex* system's three-dimensional coordinate analysis software with a commercially available software package called LabView. LabView is well known in the industry as a well-suited tool for displaying parameters and positioning. In this case it enables us to provide the user with a well laid out picture of the patient and the coordinates through icons, graphs and quantitative results.
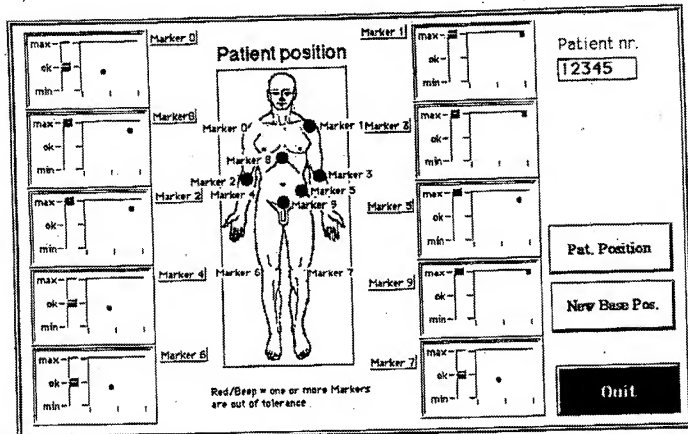
Pictured above is a video monitor screen view of the patient's position. The actual screen is in full color. The markers are shown on the patient's body. When they are green the patient is perfectly aligned. When the patient is out of alignment the markers are red and an alarm can be sounded. The actual marker misalignment can be seen for each marker as illustrated in the views around the patient. (Markers 0,4,6 and 7 are aligned and are not obvious in the picture due to their green color.)

Introduction

For the most part, patients undergoing radiation treatment for cancer curing are manually positioned through the help of positioning lasers in the radiation treatment room. During the full treatment cycle, the patient is visually monitored via video or CCD cameras by the radiologist or an assistant. As a result no quantitative data concerning the patient's movement are available for the treatment series. Repositioning accuracy of the patient during the treatment cycle is dependent on qualitative repositioning.

The MacPostion system is designed to increase the accuracy of positioning/repositioning data of the patient for use by the radiologist to maximize the efficiency of the treatment and to minimize the exposure of radiation to unwanted parts of the body.

Features

- Position resolution to 1:30,000 in field of view.
- Menu-driven patient data input.
- Alarm function if marker is out of tolerance.
- Simple diagrams display the displacement of each marker in real time.

Benefits

- Real-time monitoring of patient movement during treatment.
- Fast and accurate repositioning of patients in real time.
- Reduces the risk of unintentional treatment of unaffected areas.
- Data can be exported to standard spreadsheet programs for statistical analysis.